Appendix G:

GIS Analysis of Statewide Transmission Lines

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Draft

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GIS ANALYSIS OF STATEWIDE TRANSMISSION LINES

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I INTRODUCTION

Information on land use and census characteristics of property near transmission lines is vital to an ongoing analysis being conducted by Decision Insights, Inc. Using a statewide database of transmission lines obtained from the California Energy Commission, we randomly sampled 200 transmission lines of approximately one mile in length separately for five voltage categories. We determined within 500 feet of each side of each transmission line the distribution of land use and selected census variables using data from the U.S. Geological Survey/EPA and the U.S. Census Bureau.

II METHODS

1) Transmission Line Data

We obtained a statewide coverage of transmission lines from the California Energy Commission, Energy Facilities Siting and Environmental Protection Division. Information for transmission lines included ownership of lines (represented by line color), and voltage (represented by line weight). The dxf files (original format from the California Energy Commission) were imported into ArcView using AutoCad extension. A new coverage was created for each layer, the layer name being the name of the coverage/file. Since the attribution information was contained in the name of the coverage, a field was added to each coverage and every record of that field was updated with the name of that coverage. All of the records of every coverage were appended to one coverage. This resulted in a single file with all of the shapes and the appropriate attribution. The coverage was then reprojected to geographic projection (latitude/longitude in decimal degrees) from UTM10 projection using ArcInfo. All "Shape" field records were created and updated based on whether the shape was a polygon, polyline, line, point, or text.

All records which were lines or polylines and had a voltage described in the layer name were selected. Lines were converted to polylines and a length was computed for each segment. The transmission lines were sorted into 6 voltage categories (34-59 kV, 60-92 kV, 110-161 kV, 220-287 kV, 345-500 kV, and 500 kV DC). In each voltage category, transmission lines were segmented into lengths of exactly 1 mile, limited by the accuracy of the micro-processor and the scale of the power line coverage. Two hundred segments were then randomly chosen from each of the six power line categories by using ArcView's random number generator. Segments that were ± 10ft of one mile were included in the selection process, while segments that were outside this range were left out of the selection.

2) Land Use Data

Residential land use data for the state was obtained from the Geographic Information Retrieval and Analysis System (GIRAS) (URL: http:/www.epa.gov/nsdi/projects/giras.htm). This 1:250,000 scale quadrangle data was taken originally from NASA high elevation photography from the mid-70's to early 80's. This land use data was collected by the U.S. Geological Survey

and converted into a GIS coverage by the U.S. EPA. Land use was mapped using the Anderson land use coding system.[1] Full metadata for this coverage is attached in the appendix.

3) U.S. Census Data

Data at the block group level was used from the *Census of Population and Housing, 1990: Summary Tape File 3 for California* (STF3A). We used the following variables from this file: Persons (100% count), Black race, Hispanic origin, Median household income in 1989, and Median value (of owner-occupied units). The percent Black and Hispanic were computed by dividing the number of Blacks and Hispanics by the 100% population count for each block group (method described below). The statewide block group geographic coverage was created by combining county-level (1:100,000 scale) polygons that were derived from the Census Tiger database. The resulting coverage was then linked to the attribute data discussed above.

4) Overlay Analysis

The chosen one-mile transmission line segments were buffered in ArcView to a distance of 500 feet. The polygons resulting from the buffering process were overlaid with the GIRAS land use layer and the statewide layer of block group boundaries. For the census data, population distributions were assumed to be homogeneous throughout the block group. The block group area which overlapped the 500 ft. buffer polygon for each power line segment was computed. This percentage area was multiplied by the total population count and the number of Blacks and Hispanics for each block group to get an estimate of the percentage Black and Hispanic for each buffered polygon. For the median household income and property values, an average was computed for each variable based on weighting the estimated population in the overlaid block group area by the average income and property value for that block group.

The percentage land use for each voltage category was computed by summing all the land use polygons which overlapped the 500 ft. buffer for each power line segment. Land use and census data were summarized for each voltage category.

III RESULTS

1) Transmission line data

There was a total of 43,142.9 miles (or 227,794,646.5 feet) of statewide transmission lines in the database. Table 1 shows the distribution of the transmission lines by voltage class. The largest class was 60-92 kV with 14,840.5 miles (34.4% of the database). Table 2 shows the distribution of transmission lines by ownership class. The largest ownership category was Pacific, Gas, and Electric, with 19,116.4 miles of lines, or 44.3% of the database.

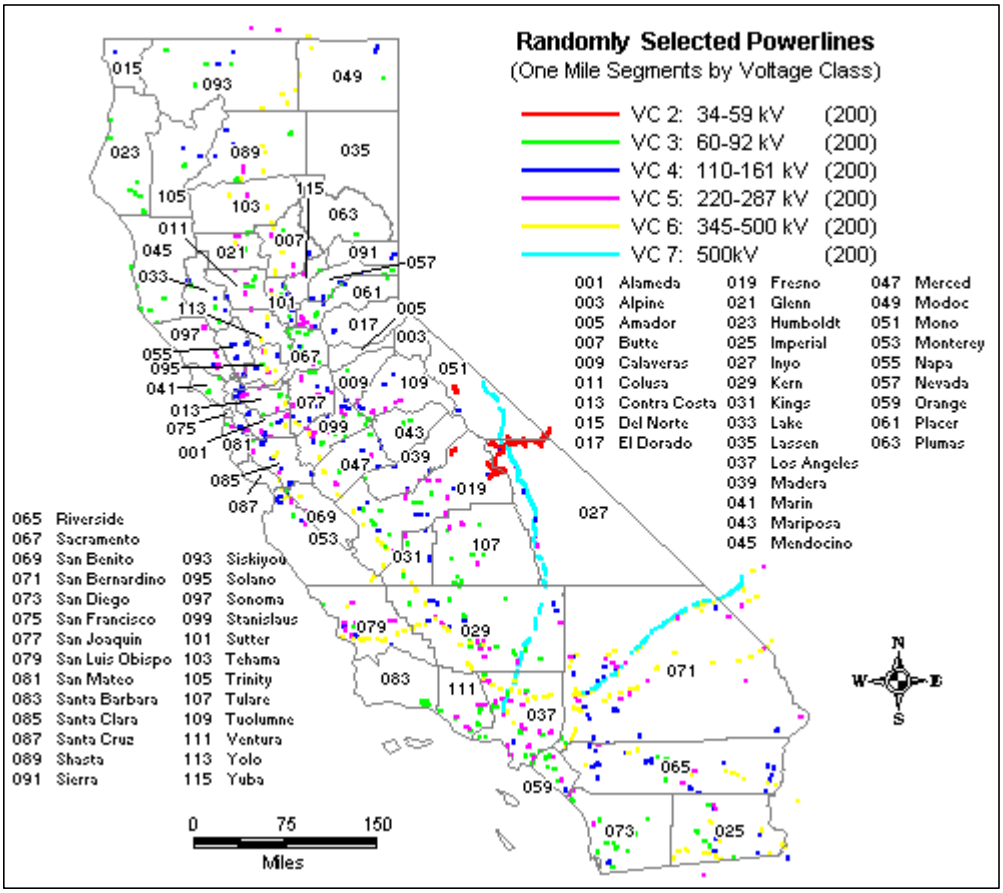
[1] Anderson JR, Hardy EE, Roach JT, Witmer RE. A land use and land cover classification system for use with remote sensor data. U.S.G.S. Professional Paper 964. Reston, VI, 1976.

Table 1: Length of Transmission Lines by Voltage Class		
VOLTAGE CLASS	**LENGTH**	
	FEET	**MILES**
2 (34-59 kV)	1,117,033.4	211.6
3 (60-92 kV)	78,357,914.5	14,840.5
4 (110-161 kV)	54,659,570.3	10,352.2
5 (220-287 kV)	66,688,398.4	12,630.4
6 (345-500 kV)	23,685,831.4	4,486.0
7 (500 kV)	3,285,898.5	622.3
Total	227,794,646.5	43,142.9

Table 2: Length of Transmission Lines by Ownership

OWNERSHIP CLASS	**LENGTH**	
	FEET	**MILES**
Bonneville Power Administration	319,889.9	60.6
Burbank Public Service Dept.	56,166.7	10.6
California – Pacific Utilities Company	514,047.3	97.4
Comision Federal de Electricidad	200,979.6	38.1
California – Oregon Transmission Project	1,877,411.5	355.6
California Department of Water Resources	188,605.8	35.7
Glendale Public Service Department	57,411.2	10.9
Imperial Irrigation District	7,439,512.3	1,409.0
Intermountain Power Agency	901,310.6	170.7
Los Angeles Dept. of Water and Power	13,456,485.9	2,548.6
Modesto Irrigation District	3,411,342.6	646.1
Metropolitan Water District of Southern California	1,069,073.4	202.5
Oroville-Wayandotte Irrigation District	153,068.7	29.0
Pacificorp	5,063,886.5	959.1
PG&E	100,934,777.8	19,116.4
Plumas –Sierra Rural Electric Corp., Inc.	597,162.9	113.1
Redding Electric Dept.	331,744.5	62.8
San Francisco City and County	3,672,670.1	695.6
Southern California Edison	62,089,137.4	11,759.3
San Diego Gas and Electric	8,808,941.4	1,668.4
Shasta Dam Area Public Utility District	65,275.2	12.4
Sierra Pacific Power Company	1,072,240.6	203.1
Sacramento Municpal Utility District	4,960,669.4	939.5
Surprise Valley Electrification Corp.	596,625.8	113.0
Turlock Irrigation District	2,221,015.6	420.6
Western Area Power Administration	7,735,193.7	1,465.0
Total	227,794,646.5	43,142.9

FIGURE 1: Distribution of Randomly-Selected Powerlines by Voltage Class



2) Land Use data

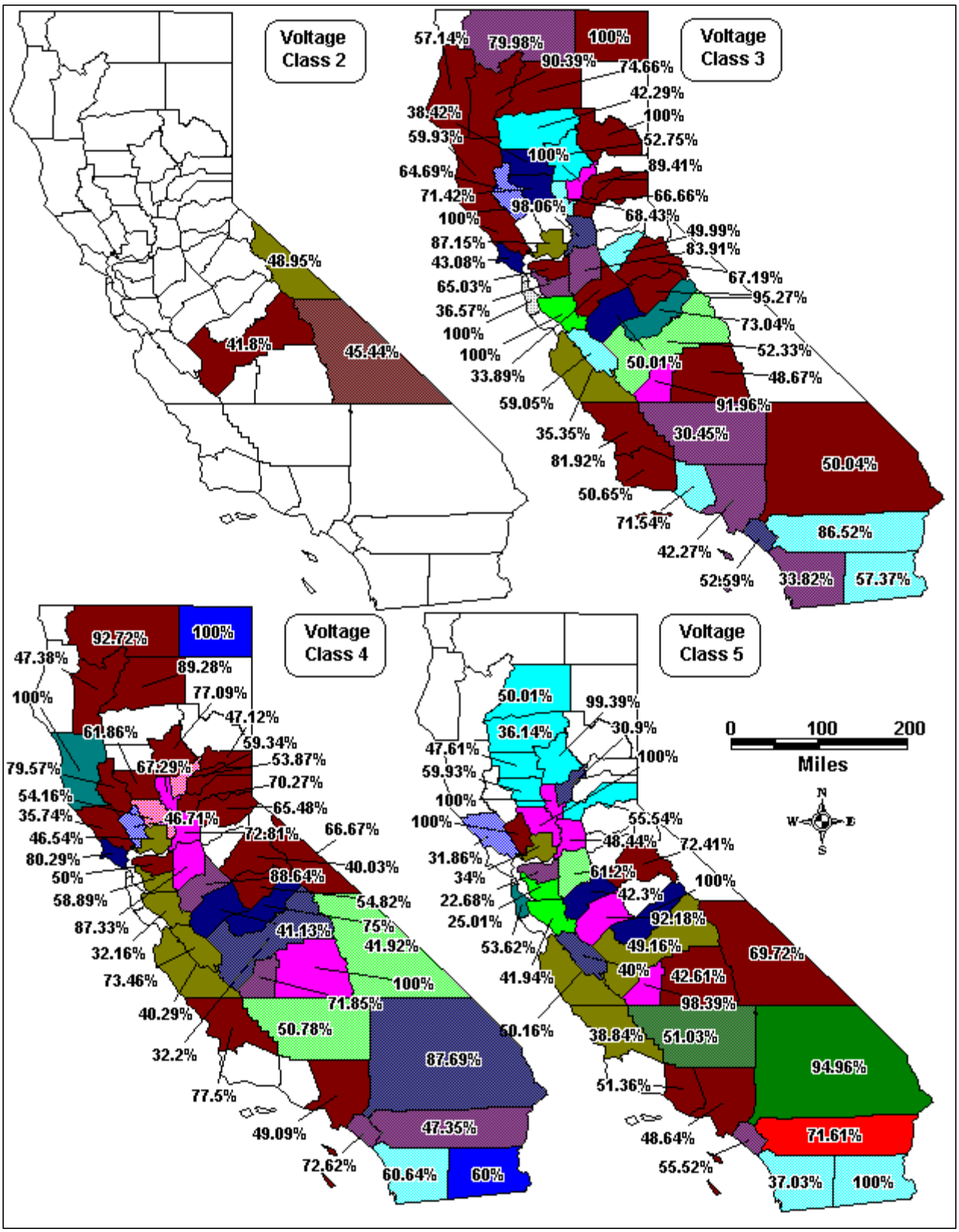
Table 3 shows the areal percentage of land use in the 500 ft. power line buffers by voltage class. The largest land use was shrub and brush rangeland, with 30.1% of the total land area. The second largest land use category was evergreen forest land, with 23.5% of the total land area. Voltage class 500 kV had the largest percentage of land use in shrub and brush rangeland, with 54.9% of the total land area for that voltage class. Voltage class 34-59 kV had the largest land use for evergreen forest land (41.0%) and for shrub and brush tundra (17.1%).

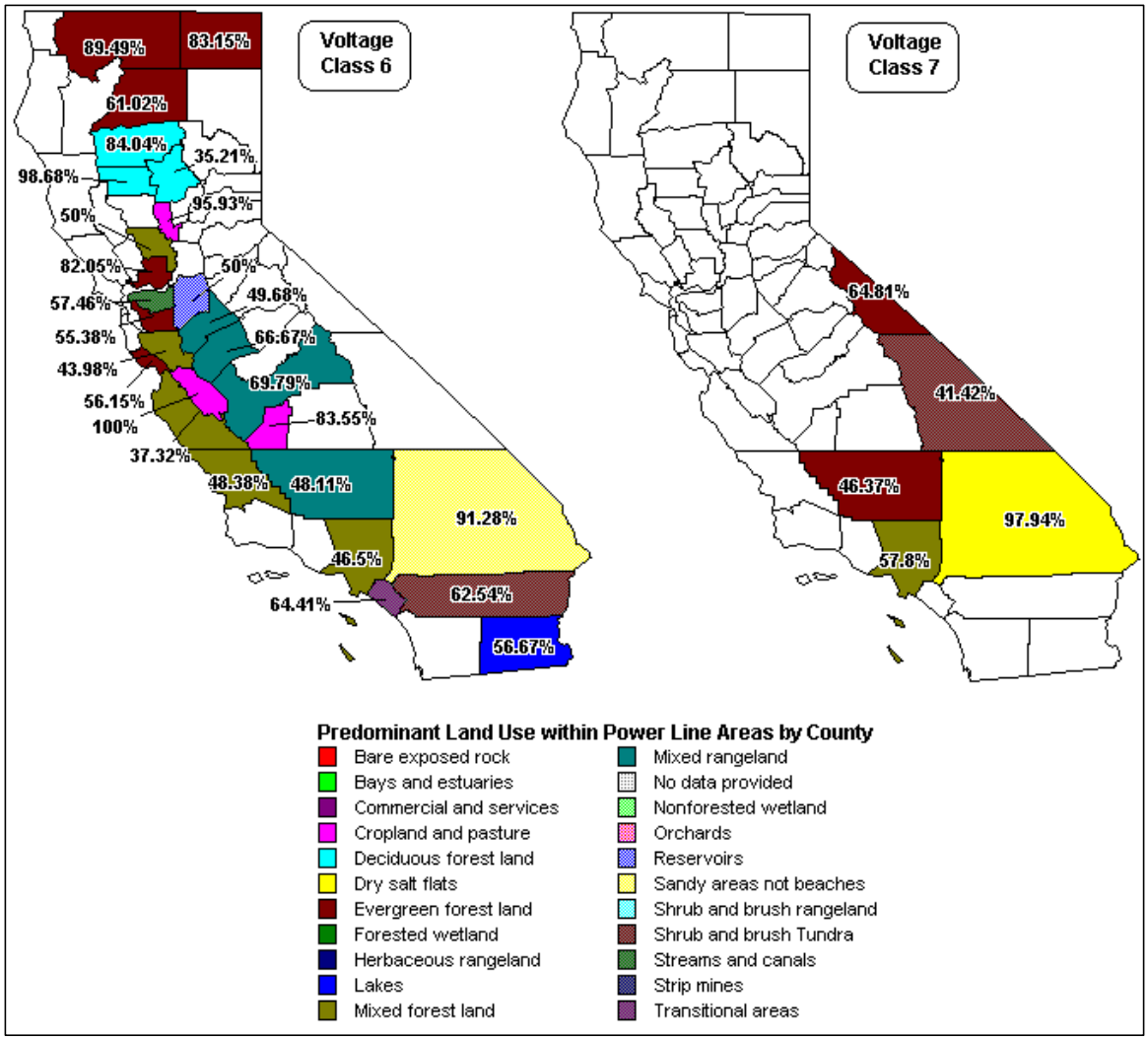
Figure 2 shows the top land use within power line buffers by county for each voltage class.

Table 3: Percentage Land Use by Voltage Class							
Land Use Class Description	Class 2 (34-59 kV)	Class 3 (60-92 kV)	Class 4 (110-161 kV)	Class 5 (220-287 kV)	Class 6 (345-500 kV)	Class 7 (500 kV)	Total Land Area by Land Use Class (mi^2)
Bare exposed rock	0.00%	0.00%	0.00%	0.38%	0.14%	0.88%	0.6
Bays and Estuaries	0.00%	1.01%	2.82%	1.83%	0.00%	0.00%	2.4
Commercial and services	0.00%	1.78%	0.53%	1.84%	2.71%	0.00%	2.9
Confined feeding operations	0.00%	0.09%	0.00%	0.01%	0.00%	0.00%	0.0
Cropland and pasture	2.24%	26.82%	23.18%	19.61%	16.33%	0.96%	38.0
Deciduous forest land	0.00%	1.33%	0.23%	2.21%	5.29%	0.00%	3.9
Dry Salt Flats	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%	0.1
Evergreen Forest Land	41.03%	25.90%	19.05%	13.70%	12.90%	28.59%	60.0
Forested wetland	0.00%	0.00%	0.17%	0.06%	0.00%	0.00%	0.1
Herbaceous Rangeland	2.25%	7.48%	4.94%	11.76%	3.65%	1.09%	13.3
Industrial	0.00%	0.94%	2.08%	1.27%	0.52%	0.00%	2.1
Lakes	0.47%	0.00%	0.51%	0.04%	1.46%	0.00%	1.1
Mixed forest land	0.72%	1.63%	5.59%	4.95%	1.63%	0.41%	6.4
Mixed Rangeland	7.38%	1.76%	2.85%	2.70%	3.81%	11.80%	12.9
Mixed urban or built-up land	0.00%	0.13%	0.10%	0.21%	0.00%	0.00%	0.2
Nonforested wetland	0.00%	1.15%	0.04%	0.90%	0.00%	0.15%	1.0
Orchards	0.00%	2.39%	7.69%	6.13%	1.27%	0.00%	7.5
Other agricultural land	0.00%	0.06%	0.04%	0.01%	0.15%	0.00%	0.1
Other urban or built-up land	0.00%	0.32%	1.74%	0.57%	1.09%	0.00%	1.6
Reservoirs	2.02%	0.59%	0.17%	0.64%	0.51%	0.00%	1.7
Residential	0.01%	5.96%	8.38%	5.96%	5.97%	0.00%	11.2
Sandy areas not beaches	0.00%	0.00%	0.19%	0.01%	0.41%	0.00%	0.3
Shrub and brush rangeland	26.83%	14.69%	18.62%	23.86%	41.41%	54.93%	76.7
Shrub and Brush Tundra	17.06%	0.00%	0.00%	0.00%	0.16%	0.84%	7.6
Streams and canals	0.00%	0.10%	0.00%	0.29%	0.38%	0.00%	0.3
Strip mines	0.00%	0.16%	0.12%	0.54%	0.05%	0.09%	0.4
Transitional areas	0.00%	1.03%	0.35%	0.13%	0.06%	0.00%	0.7
Transportation	0.00%	0.62%	0.59%	0.40%	0.10%	0.05%	0.8
Unknown	0.00%	4.05%	0.00%	0.00%	0.00%	0.00%	1.7
Total Land Area (mi^2)	42.1	42.8	42.6	42.7	42.6	42.6	255.2

1

Figure 2: Percentage of Top Land Use by County by Voltage Class





3) Census data

Table 4 shows the distribution of census characteristics in the 500 ft. buffer area of the power lines by voltage class. The largest population and population density was found near voltage class 60-92 kV, with a population of 35,514 and a population density of 879 persons per square mile. The lowest population and population density was found near voltage class 34-59 kV, with a population of 348 and a population density of 8.4 persons per square mile.

The average percentage Black population was low in all voltage classes, approximately 2-3% of the total population, except in the 34-59 kV class, with only 0.4% of the population. Average percentage Hispanic population ranged from 6 – 21% of the population, with the highest in voltage class 345-500 kV. Average median household income ranged from $26-39,000 annually, with the highest income in the 220-287 kV class. This class (220-287 kV) also had the highest average median property value ($183,302).

Figs. 3-7 show the distribution of the average values of the census variables in the power line buffers by county.

Table 4: Distribution of Census Characteristics by Voltage Class

Voltage Class	Estimated Population within Power Line Buffers	Aver. % Black Popn in Power Line Buffers (using popn estimate)	Aver. % Hispanic Popn in Power Line Buffers (using popn estimate)	Average Popn Density (persons/sq mi) within Power Line Buffers (using popn estimate)	Aver Median Household Income within Power Line Buffers (weighted by estimated popn and coincident overlay area)	Aver. Median Property Value within Power Line Buffers (weighted by estimated popn and coincident overlay area)
2 (34-59 kV)	347.69	0.38%	6.78%	8.443	$28,081.33	$123,885.66
3 (60-92 kV)	35,513.46	2.27%	21.66%	878.744	$34,707.82	$156,029.29
4 (110-161 kV)	20,374.57	3.36%	17.89%	497.147	$35,566.61	$151,493.90
5 (220-287 kV)	22,552.34	3.01%	19.98%	563.637	$39,282.91	$183,302.32
6 (345-500 kV)	1,621.68	3.63%	24.21%	43.545	$31,751.36	$128,348.18
7 (500 kV)	1,180.81	3.90%	11.21%	29.086	$26,885.85	$81,516.20

FIGURE 3: Distribution of Average Population Density in Power Line Buffers by County

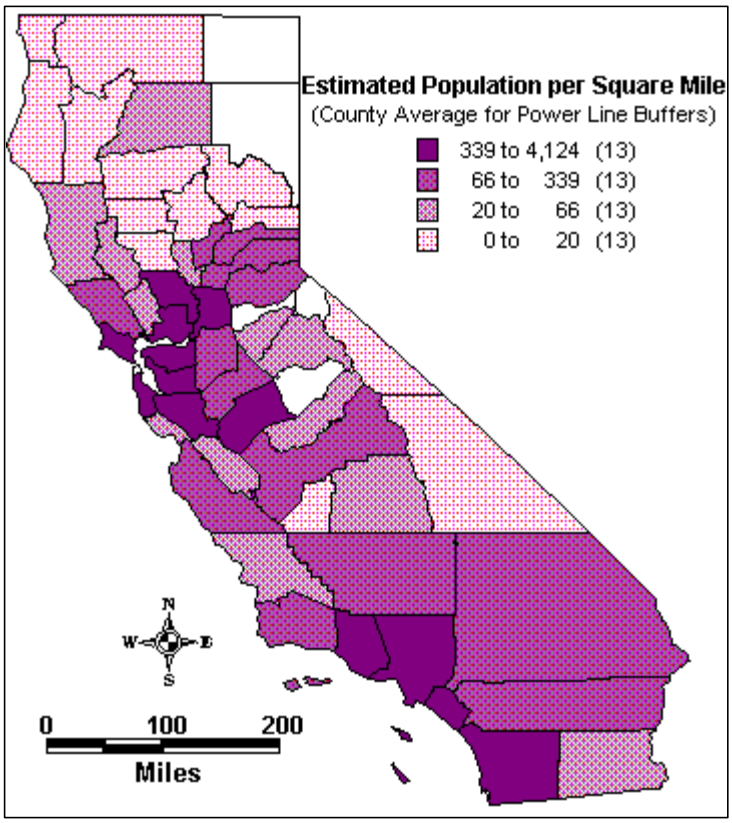


FIGURE 4: Distribution of Average Percentage Hispanic in Power Line Buffers by County

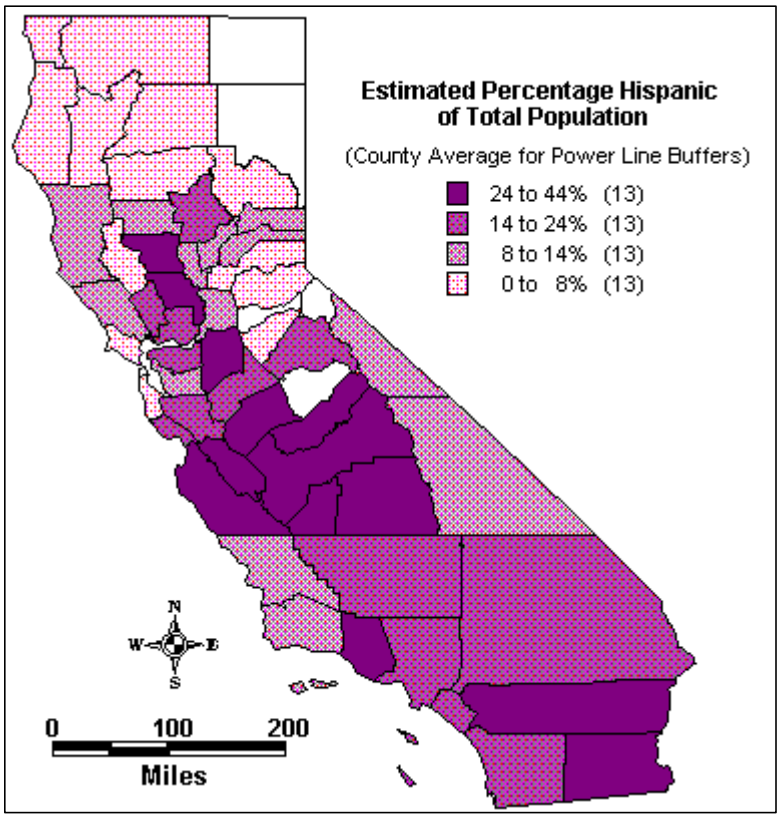


FIGURE 5: Distribution of Average Percentage Black in Power Line Buffers by County

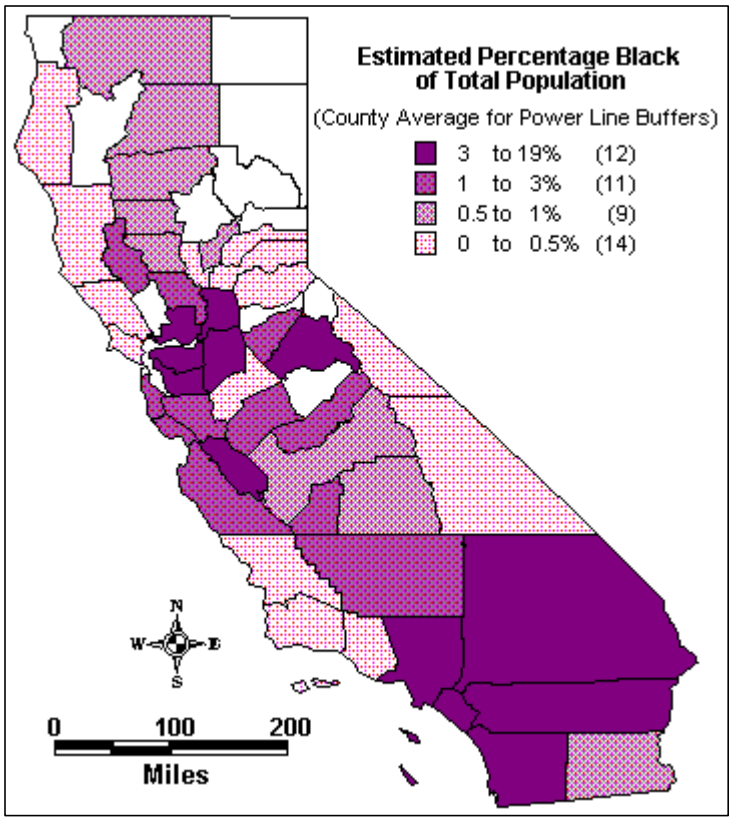


FIGURE 6: Distribution of Average Median Property Values in Power Line Buffers by County

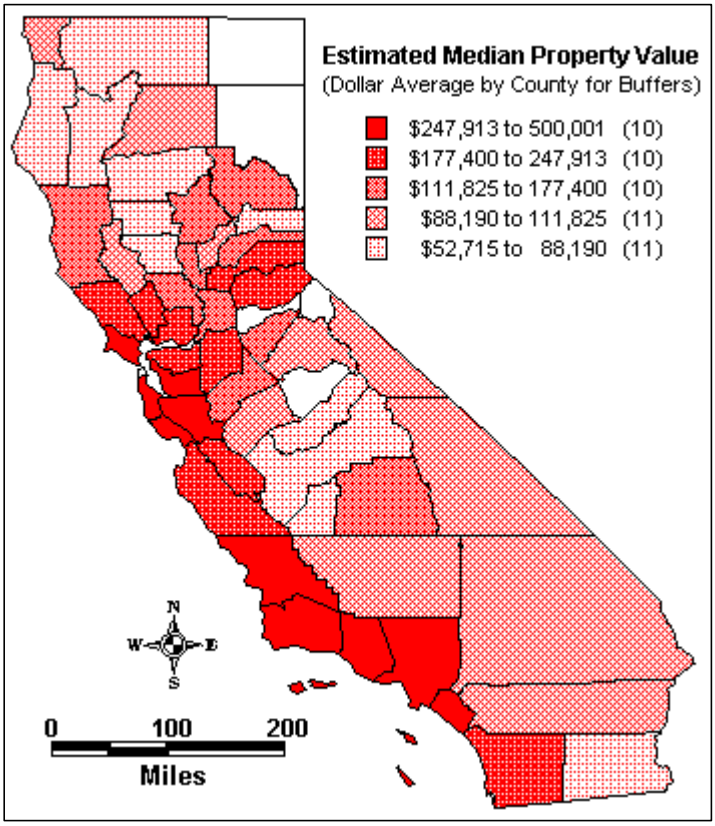
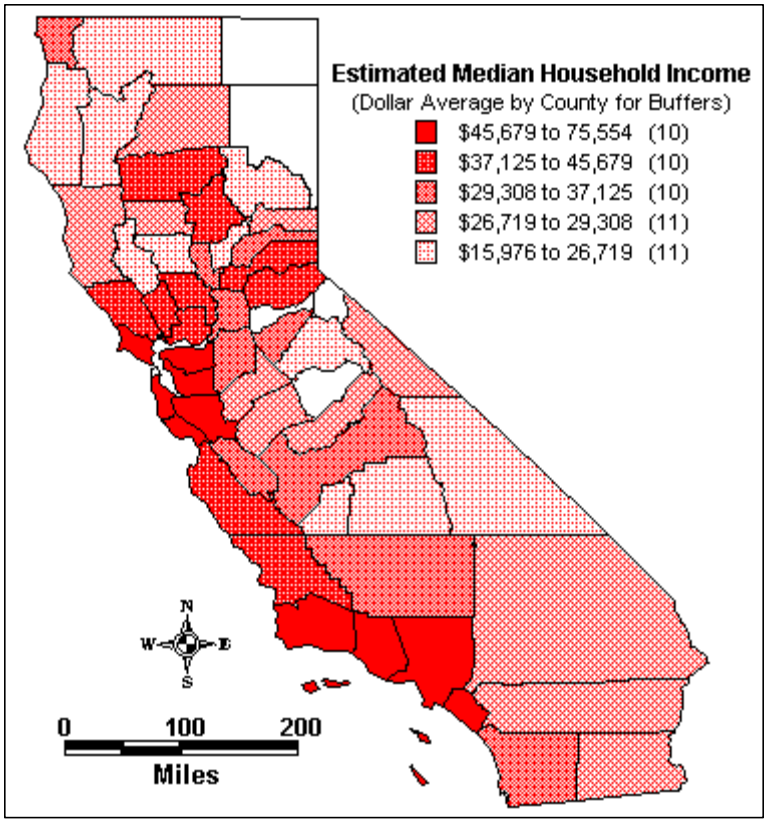


FIGURE 7: Distribution of Average Median Household Income in Power Line Buffers by County



APPENDIX:
METADATA FOR ANDERSON LAND USE CLASSIFICATION